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INFLUENCE OF NITROGEN FERTILIZER AND ELMENTAL SULPHUR LEVELS ON PRODUCTIVITY AND TECHNOLOGICAL CHARACTERISTICS OF SUGAR BEET UNDER MIDDLE EGYPT CONDITIONS

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Abstract: This work was conducted at Mallawi Agric. Res. Station, Minia Governorate, Egypt, during 2005/2006 and 2006/2007 seasons to study the effect of three nitrogen fertilizer levels , i.e. 60, 90 and 120 kg /fed and three sulphur fertilizer levels (0, 100 and 200 kg /fed.) on the yield and quality traits of Oscar poly sugar beet variety to define the treatments needed to achieve the highest yield and quality of sugar beet under Middle Egypt conditions (El Minia Governorate conditions). In addition, improving the processing season quality of sugar factory (Abou Kourkas factory) is another objective.

The obtained results indicated that nitrogen fertilizer and elemental sulphur levels

exhibited a highly significant effect on all growth characters , i.e. length,diameter and weight of root , quality parameters such as pol%, α -N, K contents,quality index, sugar recovery % of sugar beet as well as yield traits, i.e. roots and recoverable sugar yields (ton/ fed) , except α -N and quality index was not significant in related to sulphur fertilizer levels in both seasons .

Therefore, application of 100 kg S / fed. with 90 kg N / fed. for sugar beet under Middle Egypt conditions are recommended because it gave the highest value of recoverable sugar yield ton/fed per fed .

Keywords: sugar beet, sulphur, nitrogen fertilizer level ,quality index and pol,%.

Introduction

The sugar produced from sugar beet raised from 7.36% in 1990 season to about 32% of locally sugar production (1.58 million ton) in 2006 season, while locally sugar consumption was 2.3 million ton in 2006 season. Increasing the production of the unit area vertically become the main goal not only for the grower and the manufacturer but also for the policy maker to minimize the aforementioned gap between sugar production and consumption (Hassan, 2005 ;Abd

El.Wahab,2005 ;Gomaa , *et al.* 2005 and CCSC ,2006) .

Recently, sugar beet crop has an important position in Egyptian crop rotation as winter crop . Achieving higher growth and yield of sugar beet is controlled by many factors such as optimum nitrogen fertilizer level. Nitrogen is an essential element for building up protoplasm and carbohydrates of leaves (Taha, 1985). Production of high quality sugar beet is especially important to growers being paid on the extractable sucrose content of their beets . Proper nitrogen fertilizer application increases yield of both roots and sucrose . Too much nitrogen increases impurities and decreases the percentage of sucrose in the root .Production of high quality sugar beet requires that nitrogen be in adequate supply to develop an optimum canopy for photosynthesis. Nitrogen application increased root length; root diameter (Basha,1984) ; root yield (James *et al.*1978 and Halvorson & Hartman, 1980); top yield (El.Geddawy,1979) and sugar yield (Aziz *et al.* 1978 and Taha,1985) . However, excess of nitrogen fertilizer level decreased both pol% and rendement ,(Ghanem & Gomaa,1985 ; Taha,1985 ; Mohamed,2002 and Abd Elrahim, *et al.* 2005)indicated that excessive use of nitrogen fertilizer usually reduces beet quality significantly .

Most of the growing soils in Egypt has high pH. One of the major problems of soils in Egypt is therefore , low contents of available P. Sulphur application has been noted to increase available P from native soil apatite, whereas in other soils it was reported to increase available P only when P-fertilizer was added to the soil ,but soil P was notaffected (Garcia&Carloni,1977; Gupta& Mehla, 1980 and Kaplan& Orman, 1998).

The need for sulphur has never been recognized in Egyptian agriculture as a soil amendment and nutritional element . Recently , started to deal with the use of sulphur for agricultural purposes .In this respect , Nemeat-Alla, (2005) indicated that sulphur levels resulted significant differences in length and diameter of sugar beet roots , root and top yields /fed . No significant differences were detected in sugar yield /fed and sucrose % of beet roots due to sulphur fertilizer application in both seasons . He added that application of 80 kg N /fed and 200 kg S /fed could be recommended for optimum sugar beet yield under the work conditions.

The objective of this work was to determine the optimal nitrogen and sulphur levels needed to achieve the highest yield and technological qualities of sugar beet under Middle Egypt conditions (El Minia Governorate conditions). In addition to improve the processing stages of Abou Kourkas Sugar factory .

Materials and Methods

This work was conducted at Mallawi Agric. Res. Station El .Minia Governorate, Egypt, during 2005/2006 and 2006/2007 seasons . A split plot design with four replications was used . Sugar beet cultivar namely Oscar poly was sown on 5th and 7th October in both seasons . Sub plots area were 10.5 m^2 (each consisting of five rows,60 cm wide and 17 cm was between hills ,each of 3.5 meters long). Nitrogen fertilizer levels (60,90 and 120 kgs/fed.), were arranged in the main plots and three levels of sulphur ,i.e. 0.0, 100 and 200 kg /fed of the elemental S randomly distributed in the sub plots after mixing with sulphur oxidizing bacteria. Phosphorus fertilizer as calcium super phosphate fertilizer (15.5% P_2O_5) at the recommended rate of 30 kg P_2O_5/fed and sulphur fertilizer at the used level were broadcasted after ridging and before planting . Nitrogen fertilizer as NH_4NO_3 was added in two equal doses (the first one was after the thinning at four leaves stages, while the second one was added after 30 days later). Potassium fertilizer in the form of potassium sulphate fertilizer (48%) was side-dressed at recommended rate of 24 kg K_2O/fed after thinning. Some physical and chemical properties of the experimental soil type of the field were estimated according to the procedures outlined by Jackson (1967) and Olsen & Sommers (1982) . The mechanical and chemical analysis of experimental site soil showed that the soil was silty clay loam , containing 18.2 and 16.10 ppm of available nitrogen ,12.05 and 13.60 ppm P , as well as 206.00 and 188.00 ppm K with a pH (1:2.5 water suspension) of 7.71 and 7.74 in 2005/2006 and 2006/2007 seasons, respectively .

The recorded data in this work were as follow:

A-Growth traits: At harvest (at age 195 days from sowing), ten roots of sugar beet from each plot were uprooted for measuring root length and diameter (cm) as well as root weight (kg) .

B- Quality characteristics: A samples of twenty roots were taken at random, send to the laboratory ,cleaned with running tap water,dried , each sample was grated separately with grater into cossettes and mixed thoroughly to determine the quality characteristics. 1.Pol % was estimated in fresh samples of sugar beet roots, using saccharometer according to the method described in AOAC, (2000).

2.Alpha amino nitrogen, sodium and potassium contents : Its were determined according to the procedure of sugar company by Auto analyzer as described in Cooke and Scott(1993). The results calculated as milliequivalent per 100 gm beet.

3.Sugar recovery % was calculated using the following equation according to Cooke and Scott (1993): Sugar recovery % = Pol,%-[0.29 + 0.343 (K + Na) + α - N (0.094)]. Where, K, Na and α - N determined as milliequivalent/100 g beet.

4.Quality index was using the following formula:

Quality index, % = Rendement % X 100 ÷ Pol %

C- Productivity traits:

1.Roots yield (ton /fed): At harvest (at age 195 days from sowing) plants of sugar beet from each plot were harvested to determine roots yield and top yield as ton /fed on fresh weight basis.

2.Recoverable sugar yield (ton/fed) was calculated from the following equation : Recoverable sugar yield (ton/fed)= Roots yield (ton /fed) X Sugar recovery % .

Data collected were subjected to the proper analysis of variance (ANOVA). The proper statistical of all data was carried out according to lined by Gomez & Gomez(1984). Homogeneity of variance was examined before combined analysis. Differences among treatments were evaluated by the least significant difference test (LSD) at 5 %.

Results and Discussion

A- Growth traits :

The given results in Tables (1-3) indicated that nitrogen fertilizer levels had a highly significant effect on growth traits of sugar beet , i.e. root length and diameter (cm) as well as root weight (kg)/plant in the two growing seasons. It could be noticed from combined analysis that increasing nitrogen fertilizer level from 60 to 120 kg N/fed, significantly increased root dimensions (root length and diameter (cm)) and root weight (kg)/plant.The highest nitrogen fertilizer level(120 kg N/fed)scored the highest values of root dimensions and root weight (kg)/plant , while the lowest nitrogen fertilizer level(60 kg N/fed) recorded the lowest values . The presented results might be principally due to the role of nitrogen in developing root dimensions by increasing division or elongation of cell. Whereas , increasing nitrogen fertilizer level up to 90 kg / fed. enhanced growth attributes of sugar beet (Sarhan, 1998 ; El Hawary, 1999 and Attia *et al.*2004). They revealed that the increment of growth attributes gained by increasing nitrogen fertilizer level may be due to the role of nitrogen in developing root dimensions by increasing division or elongation of cells and also enhancing leaf initiation and increment chlorophyll concentration in leaves and photosynthesis process.This was associated with accumulation of carbohydrates

translated from leaves to develop roots ,consequently increasing root size . The aforementioned findings are in agreement with those of Sarhan (1998) ; Attia *et al.* (2004) ; Nemeat-Alla,(2005) and Gomaa,*et al.* (2005) .

Concerning the effect of elemental sulphur levels, the data in Tables(1-3) showed that there were a highly significant differences in root length and diameter (cm) as well as root weight (kg)/plant of sugar beet among the studied elemental sulphur levels in both two seasons . It could be concluded from combined analysis that increasing sulphur fertilizer levels from 0 to 100 and 200 kg / fed. led to increase in root length (cm)of sugar beet by 2.77 and 4.74% ; root diameter (cm) of sugar beet by 2.69 and 5.61% as well as root weight (kg)/plant of sugar beet by 5.63 and 7.29% respectively.The aforementioned findings are in the same trend with those reported by El.Kammah and Ali (1986) and Nemeat-Alla, (2005).

Table (1): Effect of sulphur and nitrogen fertilizers levels on root length (cm) of sugar beet .

Sulphur fertilizer levels (B)	2005/2006 season				2006/2007 season				Combined			
	Nitrogen fertilizer levels(A)											
	60kg/fed	90kg/fed	120kg/fed	Mean	60kg/fed	90kg/fed	120kg/fed	Mean	60kg/fed	90kg/fed	120kg/fed	Mean
0 kg/fed	28.30	29.90	31.13	29.78	28.60	30.20	31.50	30.10	28.45	30.05	31.32	29.44
100 kg/fed	28.80	30.97	32.27	30.68	29.07	31.53	32.00	30.87	28.93	31.25	32.13	30.77
200 kg/fed	29.17	32.20	32.60	31.32	29.20	32.60	32.37	31.39	29.18	32.40	32.48	31.36
Mean	28.76	31.02	32.00	30.59	28.96	31.44	31.96	30.79	28.86	31.23	31.98	30.69
F test	**	**	*		**	**	**		A=0.58	B=0.18	AB=0.30	
LSD .05	A=0.81	B=0.34	AB=0.58		A=1.14	B=0.16	AB=0.27		AY=-	BY=-	ABY=-	

Where Y= Year N.s = Non significant

Table (2): Effect of sulphur and nitrogen fertilizers levels on root diameter (cm) of sugar beet.

Sulphur fertilizer levels(B)	2005/2006 season				2006/2007 season				Combined			
	Nitrogen fertilizer levels(A)											
	60kg/fed	90kg/fed	120kg/fed	Mean	60kg/fed	90kg/fed	120kg/fed	Mean	60kg/fed	90kg/fed	120kg/fed	Mean
0 kg/fed	12.33	13.40	14.13	13.29	12.57	13.47	14.30	13.44	12.45	13.43	14.22	13.37
100 kg/fed	12.67	13.63	14.53	13.61	12.83	13.90	14.80	13.84	12.75	13.77	14.67	13.73
200 kg/fed	12.97	14.23	15.00	14.07	13.10	14.37	15.07	14.18	13.03	14.30	15.03	14.12
Mean	12.66	13.76	14.56	13.66	12.83	13.91	14.72	13.82	12.74	13.83	14.64	13.74
F test	**		**	Ns	**		**	Ns	A=0.17		B=0.11	AB=-
LSD .05	A=0.38		B=0.17	AB=-	A=0.14		B=0.15	AB=-	AY=-		BY=-	ABY=-

Highly significant interaction effect between nitrogen fertilizer levels x elemental sulphur levels (AB) with regard to root length (cm) of sugar beet was scored in Table (1) except the first season was significant only. The highest values of root length (32.48 cm) of sugar beet was obtained with 120 kg N / fed and 200 kg S/ fed.

B- Quality parameters:

Beet quality is not a single parameter , but it is combination of all the chemical and physical aspects of beet root which influence processing efficiency .

Table (3): Effect of sulphur and nitrogen fertilizers levels on root weight (kg/plant) of sugar beet.

Sulphur fertilizer levels(B)	2005/2006 season				2006/2007 season				Combined			
	Nitrogen fertilizer levels(A)											
	60kg/fed	90kg/fed	120kg/fed	Mean	60kg/fed	90kg/fed	120kg/fed	Mean	60kg/fed	90kg/fed	120kg/fed	Mean
0 kg/fed	0.913	1.180	1.210	1.101	0.927	1.170	1.233	1.110	0.920	1.175	1.222	1.106
100 kg/fed	0.977	1.230	1.277	1.161	0.987	1.253	1.283	1.174	0.982	1.242	1.280	1.168
200 kg/fed	0.983	1.253	1.297	1.178	1.003	1.273	1.307	1.194	0.993	1.263	1.302	1.186
Mean	0.958	1.221	1.261	1.470	0.972	1.232	1.274	1.160	0.965	1.227	1.268	1.153
F test	**		**	Ns	**		**	Ns	A=0.03		B=0.02	AB=-
LSD .05	A=0.06		B=0.03	AB=-	A=0.06		B=0.02	AB=-	AY=-		BY=-	ABY=-

B –1- Physical properties:

The recorded data in this work (Tables 4&5) revealed that nitrogen fertilizer levels had a highly significant effect on quality index and rendement or sugar recovery % of sugar beet in both seasons .It could be noted from combined analysis that the increase in level of nitrogen fertilizer from 60 to 90 and 120 kg/fed.led to gradually decrease in quality index and rendement or sugar recovery % of sugar beet . The need for nitrogen in sugar beet production is well documented , but it has also been demonstrated that excess nitrogen fertilizer may decrease the sucrose % or pol% ,thereby lowering the sugar recovery %.Whereas, excessive nitrogen reduced sucrose % of beet roots by partitioning of more photosynthetic to tops than the roots of sugar beet plants and the increase in nitrogen non-sucrose substances such as proteins , amino acids and other substances of beet root and consequently decreasing quality index and sugar recovery % of sugar beet . Such data confirmed the previous reports of El Hawary (1999); El Shafai (2000);Badawi *et al.* (2004) Nemeat-Alla,(2005) and Gomaa,et al. (2005) who indicated similar findings.

Elemental sulphur level had a highly significant effect on rendement or sugar recovery % of sugar beet and insignificant effect on quality index in both seasons as shown in Tables 4&5 .It could be noted from combined analysis that The highest values of quality index and rendement or sugar recovery % of sugar beet were recorded with 100 S kg / fed than the other two levels of elemental sulphur (0 and 200 S kg /fed.). This is to be expected because the highest increase in pol% of sugar beet was found with adding100 S kg / fed. as shown in Table (6) .The aforementioned findings are in the same trend with those reported by Nemeat-Alla,(2005).

Table (4): Effect of sulphur and nitrogen fertilizers levels on quality index of sugar beet.

Sulphur fertilizer levels(B)	2005/2006 season				2006/2007 season				Combined			
	Nitrogen fertilizer levels(A)											
	60kg/fed	90kg/fed	120kg/fed	Mean	60kg/fed	90kg/fed	120kg/fed	Mean	60kg/fed	90kg/fed	120kg/fed	Mean
0 kg/fed	85.68	81.39	79.19	82.09	87.72	83.15	79.71	83.53	86.70	82.27	79.45	82.81
100 kg/fed	85.70	82.67	80.79	83.05	85.96	83.02	80.86	83.28	85.83	82.84	80.82	83.17
200 kg/fed	85.29	82.65	80.65	82.87	85.52	83.08	81.05	83.22	85.41	82.87	80.85	83.04
Mean	85.56	82.24	80.21	82.67	86.40	83.08	80.54	83.34	85.98	82.66	80.37	83.01
F test	**		Ns	Ns	**		Ns	Ns	A=0.88		B=-	AB=1.26
LSD .05	A=1.66		B=-	AB=-	A=1.30		B=-	AB=-	AY=-		BY=-	ABY=-

Table(5): Effect of sulphur and nitrogen fertilizers levels on rendement (sugar recovery %) of sugar beet.

Sulphur fertilizer levels(B)	2005/2006 season				2006/2007 season				Combined			
	Nitrogen fertilizer levels(A)											
	60kg/fed	90kg/fed	120kg/fed	Mean	60kg/fed	90kg/fed	120kg/fed	Mean	60kg/fed	90kg/fed	120kg/fed	Mean
0 kg/fed	14.64	13.19	11.83	13.22	14.67	13.51	12.04	13.41	14.66	13.35	11.93	13.31
100 kg/fed	15.80	14.55	13.22	14.52	16.02	14.67	13.21	14.63	15.91	14.61	13.22	14.58
200 kg/fed	15.72	14.33	13.12	14.39	15.71	14.57	13.21	14.49	15.72	14.45	13.17	14.44
Mean	15.39	14.02	12.72	14.04	15.47	14.25	12.82	14.18	15.43	14.14	12.77	14.11
F test	**		**	Ns	**		**	Ns	A=0.37	B=0.30	AB=1.26	
LSD .05	A=0.81		B=0.42	AB=-	A=0.35		B=0.48	AB=-	AY=-	BY=-	ABY=-	

Insignificant interaction effect between nitrogen fertilizer levels x elemental sulphur levels (AB)with regard to rendement or sugar recovery % and quality index of sugar beet in both seasons of sugar beet was scored in Tables (4&5) except the combined analysis was highly significant for rendement or sugar recovery % and significant for quality index. This is to be expected because the data in the first season was higher than the other season. The highest values of rendement or sugar recovery % and quality index of sugar beet of sugar beet were obtained with 60 kg N / fed and 100 kg S/ fed.

B –2- Chemical constituents:

The recorded data in this work (Tables, 6-9)clarified that nitrogen fertilizer levels had a highly significant effect on pol%, alpha amino nitrogen (α-N),sodium and potassium contents of sugar beet in both seasons except the first season for sodium content was insignificant .It could be noted from combined analysis that the increase in level of nitrogen fertilizer from 60 to 90 and 120 kg /fed. led to gradually decrease in pol% and increasing α amino-N , Na and K contents of sugar beet . Where, there were an increase in the absorption of Na and K elements from the soil by roots with increasing nitrogen fertilizer level, consequently increasing Na and K contents of beet roots . Such data confirmed the previous reports of El.Hawary (1999); El.Shafai (2000);Badawi *et al.* (2004) Nemeat-Alla, (2005) and Gomaa, *et al.* (2005) who indicated similar findings.

Elemental sulphur level had a highly significant effect on pol% and potassium content of sugar beet in both seasons of sugar beet and insignificant effect on alpha amino nitrogen (α-N)and sodium content of sugar beet in both seasons as shown

in Tables, 6-9.It could be noted from combined analysis that The highest values of pol% and potassium content of sugar beet were recorded with 100 S kg / fed than the other two levels of sulphur fertilizer (0 and 200 S kg /fed.). This is to be expected because the highest increase in pol% and potassium content of sugar beet was found with adding100 S kg / fed. as shown in Tables (6&8) .The aforementioned data are disagree with those reported by Nemeat-Alla,(2005).He indicated that there were insignificant differences among S-levels on pol% and purity % of sugar beet .This different might be due to the differences in the studied cultivar , soil and environmental conditions .

Table(6): Effect of sulphur and nitrogen fertilizers levels on pol% of sugar beet.

Sulphur fertilizer levels(B)	2005/2006 season				2006/2007 season				Combined			
	Nitrogen fertilizer levels(A)											
	60kg/fed	90kg/fed	120kg/fed	Mean	60kg/fed	90kg/fed	120kg/fed	Mean	60kg/fed	90kg/fed	120kg/fed	Mean
0 kg/fed	17.08	16.10	14.93	16.04	17.00	16.23	15.10	16.11	17.04	16.17	15.02	16.08
100 kg/fed	18.43	17.50	16.37	17.43	18.63	17.67	16.33	17.54	18.53	17.58	16.35	17.49
200 kg/fed	18.43	17.33	16.27	17.34	18.37	17.53	16.30	17.40	18.40	17.43	16.28	17.37
Mean	17.98	16.98	15.86	16.94	18.00	17.14	15.91	17.02	17.99	17.06	15.88	16.98
F test	**		**	Ns	**		**	Ns	A=0.36		B=0.27	AB=-
LSD .05	A=0.77		B=0.39	AB=-	A=0.39		B=0.41	AB=-	AY=-		BY=-	ABY=-

Table(7): Effect of sulphur and nitrogen fertilizers levels on α-N content* of sugar beet.

Sulphur fertilizer levels(B)	2005/2006 season				2006/2007 season				Combined			
	Nitrogen fertilizer levels(A)											
	60kg/fed	90kg/fed	120kg/fed	Mean	60kg/fed	90kg/fed	120kg/fed	Mean	60kg/fed	90kg/fed	120kg/fed	Mean
0 kg/fed	1.40	1.82	2.20	1.81	1.43	1.90	2.13	1.82	1.42	1.86	2.17	1.81
100 kg/fed	1.45	1.77	2.00	1.74	1.47	1.80	1.97	1.74	1.46	1.78	1.98	1.74
200 kg/fed	1.50	1.87	2.03	1.80	1.63	1.83	1.93	1.80	1.57	1.85	1.98	1.80
Mean	1.45	1.82	2.08	1.78	1.51	1.84	2.01	1.79	1.48	1.83	2.04	1.79
F test	**		Ns	Ns	**		Ns	Ns	A=0.08		B=-	AB=-
LSD .05	A=0.15		B=-	AB=-	A=0.10		B=-	AB=-	AY=-		BY=-	ABY=-

α- N content *= Alpha amino nitrogen as milliequavalents / 100 gm beet * .

Table (8): Effect of sulphur and nitrogen fertilizers levels on Na content* of sugar beet.

Sulphur fertilizer levels(B)	2005/2006 season				2006/2007 season				Combined			
	Nitrogen fertilizer levels(A)											
	60kg/fed	90kg/fed	120kg/fed	Mean	60kg/fed	90kg/fed	120kg/fed	Mean	60kg/fed	90kg/fed	120kg/fed	Mean
0 kg/fed	1.20	1.33	1.40	1.31	1.13	1.27	1.43	1.28	1.17	1.30	1.42	1.29
100 kg/fed	1.24	1.37	1.43	1.35	1.23	1.30	1.40	1.31	1.24	1.34	1.42	1.33
200 kg/fed	1.38	1.37	1.47	1.41	1.33	1.37	1.37	1.36	1.36	1.37	1.42	1.38
Mean	1.27	1.36	1.43	1.35	1.23	1.31	1.40	1.32	1.25	1.33	1.42	1.34
F test	Ns		Ns	Ns	**		Ns	Ns	A=0.08		B=-	AB=-
LSD .05	A=-		B=-	AB=-	A=0.10		B=-	AB=-	AY=-		BY=-	ABY=-

Na content *= Sodium as milliequavalents / 100 gm beet * .

Insignificant interaction effect between nitrogen fertilizer levels x elemental sulphur levels (AB)with regard to pol%, alpha amino nitrogen (α-N),sodium and potassium contents of sugar beet in both seasons of sugar beet was scored in Tables (6-9) except the combined analysis was significant for alpha amino nitrogen (α-N)and potassium contents of sugar beet. This is to be expected because the data in the first season was higher than the other season for potassium content of sugar beet . The highest value of potassium content of sugar beet were obtained with 120 kg N / fed and 100 kg S/ fed.

Table (9): Effect of sulphur and nitrogen fertilizers levels on K content* of sugar beet.

Sulphur fertilizer levels(B)	2005/2006 season				2006/2007 season				Combined			
	Nitrogen fertilizer levels(A)											
	60kg/fed	90kg/fed	120kg/fed	Mean	60kg/fed	90kg/fed	120kg/fed	Mean	60kg/fed	90kg/fed	120kg/fed	Mean
0 kg/fed	4.70	5.80	6.20	5.57	4.43	5.67	6.07	5.39	4.57	5.73	6.13	5.48
100 kg/fed	5.20	5.93	6.33	5.82	5.17	6.10	6.33	5.87	5.18	6.02	6.33	5.84
200 kg/fed	5.27	6.03	6.30	5.87	5.13	5.90	6.27	5.77	5.20	5.97	6.28	5.82
Mean	5.06	5.92	6.28	5.75	4.91	5.89	6.22	5.67	4.98	5.91	6.25	5.71
F test	**		*	Ns	**		**	Ns	A=0.19	B=0.14		AB=0.24
LSD .05	A=0.42		B=0.20	AB=-	A=0.28		B=0.21	AB=-	AY=-	BY=-		ABY=-

K content *= Potassium as milliequavalents / 100 gm beet *

C– Yield traits :

The recorded data in Tables (10&11) indicated clearly that nitrogen fertilizer level had a highly significant effect on root and recoverable sugar yields (ton/fed) of sugar beet in the two growing seasons . It could be noted from combined analysis that the increase in level of nitrogen fertilizer from 60 to 90 and 120 kg /fed. led to gradually increase in roots yields(ton/fed) of sugar beet . While , The hightest value of recoverable sugar yield (ton/fed) of sugar beet was scored with 90 N kg /fed than 60 and 120 kg /fed. . The increase in root yield (ton/fed) caused by nitrogen application might be due to the favorable effect of nitrogen in building up the photosynthetic area of beet plants and consequently accumulation of more dry matter in root .Here too, the increase in recoverable sugar yields (ton/fed) of sugar beet with increasing nitrogen fertilizer level might principally be attributed to the increase in root yield (ton/fed.).Such data confirmed the previous reports of El.Shafai (2000);Badawi *et al.* (2004) Nemeat-Alla,(2005); Osman(2005) and Gomaa,*et al.* (2005) who indicated similar findings.

Regarding elemental sulphur level, it had a highly significant effect on root and recoverable sugar yields (ton/fed) of sugar beet in the two growing seasons of sugar beet in both seasons of sugar beet and insignificant effect on alpha amino nitrogen (α-N)and sodium content of sugar beet in both seasons as shown in Tables (6-9).It could be noted from combined analysis that the increase in level of elemental sulphur from 0 to 100 and 200 kg /fed. led to gradually increase in roots and recoverable sugar yields (ton/fed) of sugar beet .The increase in roots and recoverable sugar yields (ton/fed) of sugar beet with increasing level of elemental sulphur might be due to increasing the availability of different nutrient elements (El- Kammah & Ali ,1986). The aforementioned data are agree with those reported by Nemeat-Alla,(2005).He recorded that there were significant differences among S-levels on roots and recoverable sugar yields (ton/fed) of sugar beet.

Table (10): Effect of sulphur and nitrogen fertilizers levels on roots yield (ton /fed) of sugar beet.

Sulphur fertilizer levels(B)	2005/2006 season				2006/2007 season				Combined			
	Nitrogen fertilizer levels(A)											
	60kg/fed	90kg/fed	120kg/fed	Mean	60kg/fed	90kg/fed	120kg/fed	Mean	60kg/fed	90kg/fed	120kg/fed	Mean
0 kg/fed	27.43	35.33	36.30	33.02	27.73	35.07	37.00	33.27	27.58	35.20	36.65	33.14
100 kg/fed	29.33	36.87	38.23	34.81	29.57	37.63	38.50	35.23	29.45	37.25	38.37	35.02
200 kg/fed	29.53	37.53	38.90	35.32	30.10	38.27	39.17	35.84	29.82	37.90	39.03	35.58
Mean	28.77	36.58	37.81	34.39	29.13	36.99	38.22	34.78	28.95	36.78	38.02	34.59
F test	**		**	Ns	**		**	Ns	A=1.01	B=0.51	AB=-	
LSD .05	A=1.83		B=0.86	AB=-	A=1.59		B=0.65	AB=-	AY=-	BY=-	ABY=-	

Table (11): Effect of sulphur and nitrogen fertilizers levels on sugar yield (ton /fed) of sugar beet.

Sulphur fertilizer levels(B)	2005/2006 season				2006/2007 season				Combined			
	Nitrogen fertilizer levels(A)											
	60kg/fed	90kg/fed	120kg/fed	Mean	60kg/fed	90kg/fed	120kg/fed	Mean	60kg/fed	90kg/fed	120kg/fed	Mean
0 kg/fed	4.01	4.66	4.30	4.32	4.07	4.75	4.46	4.42	4.04	4.70	4.38	4.37
100 kg/fed	4.64	5.36	5.05	5.02	4.74	5.52	5.08	5.11	4.69	5.44	5.07	5.07
200 kg/fed	4.64	5.38	5.11	5.04	4.73	5.57	5.17	5.16	4.68	5.48	5.14	5.10
Mean	4.43	5.13	4.82	4.79	4.51	5.28	4.90	4.90	4.47	5.21	4.86	4.85
F test	**		**	Ns	**		**	Ns	A=0.18		B=0.12	AB=-
LSD .05	A=0.28		B=0.14	AB=-	A=0.32		B=020	AB=-	AY=-		BY=-	ABY=-

Insignificant interaction effect between nitrogen fertilizer levels x elemental sulphur levels (AB)with regard to roots and recoverable sugar yields (ton/fed) of sugar beet in both seasons of sugar beet was scored in Tables (11-13) except the combined analysis was significant for top yield (ton/fed) of sugar beet. This is to be expected because the data in the first season were higher than the other season.

Therefore, application of 100 kg S / fed. with 90 kg N / fed. for sugar beet under Middle Egypt conditions are recommended because its gave the highest value of recoverable sugar yield ton/fed per fed. Production of high quality sugar beet requires that nitrogen be in adequate supply to develop an optimum canopy for photosynthesis. Whereas,the optimal nitrogen fertilizer and sulphur levels had highest values of recoverable sugar yields (ton/fed) , pol% and sugar recovery% (rendement%).

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تأثير مستويات السماد النيتروجيني و الكبريت العنصرى على الإنتاجية والصفات التكنولوجية لمحصول بنجر السكر تحت ظروف مصر الوسطى

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****قسم المحاصيل ، كلية الزراعة ، جامعة جنوب الوادى ، جمهورية مصر العربية**

أقيمت تجربتين حقليتين بمحطة البحوث الزراعية بملوى ،محافظة المنيا ،مصر خلال موسمى٢٠٠٥ /٢٠٠٦، ٢٠٠٦/٢٠٠٧ لدراسة تأثير ثلاث مستويات من السماد النيتروجين هي ٦٠ ، ٩٠ و ١٢٠ كجم / ف وثلاثة مستويات من الكبريت العنصرى هى ٠ ، ١٠٠ و ٢٠٠ كجم / ف في تصميم قطع منشقة مرة واحدة على الصفات الخضرية ، المحصولية وكذلك صفات الجودة التكنولوجية لجذور صنف اوسكار بولى ، لتحديد المعاملات المثلي تحت ظروف مصر الوسطي(ظروف محافظة المنيا) التى تحقق الجودة والإنتاجية العالية من محصول بنجر .

أوضحت النتائج المتحصل عليها الأتي :

١ – أحدثت كلا من مستويات السماد النيتروجيني و مستويات الكبريت العنصري تأثيرا معنويا على جميع الصفات الخضرية (طول ، سمك ووزن الجذر) ، صفات الجودة التكنولوجية مثل نسبة السكر في جذور البنجر ، كميات ألفا أمنيو نتروجين ،البوتاسيوم ، معامل الجودة ، نسبة استخراج السكر ، وكذلك الصفات الإنتاجية { ناتج الجذور النظيفة و ناتج السكر القابل للاستخراج (طن /فدان)} عدا كميات ألفا أمنيو نتروجين ومعامل الجودة كانت غير معنوية بالنسبة لمستوى السماد النيتروجيني في كلا الموسمين الزراعيين.

٢ – سجلت المعاملة المكونة من مستوى السماد النيتروجيني (٩٠ كجم نيتروجين / ف) و مستوى الكبريت العنصرى (١٠٠ كجم كبريت / ف) القيمة الأعلى من السكر القابل للاستخراج (٥,٤٤ طن/ ف) .

٣– بناء على ذلك وجد ان هذة المعاملة تحت ظروف التجربة تؤدى الى زيادة كمية وجودة البنجر المورد للمصنع وبالتالى زيادة كفاءة تشغيل مصنع ابوقرقاص.